# HM5 vs. BCPM3

**Scorecard on Customer Location and Network Modeling Issues**

## Counting Customers

- Issue: LECs report number of customer lines only at the study area level. The number of customers in specific smaller geographic areas must be estimated.
- Both models use counts at the Census Block (~7 million CBs nationwide) for target counts of customer locations

## Counting customers - res

- BCPM uses 1990 census data by CB, adjusted per 1995 county-level estimates
- HM uses 1997 Metromail customer location data at CB level, reconciled to 1996 Claritas estimates at Census Block Group (CBG) level
- Scorecard: BCPM data are stale, and information is accurate only to the county level

## Counting Lines

- LECs only report line counts at the study area level
- Some customers have more than one line, other customers have no lines
- Number of lines in specific geographic areas must be estimated

## Counting Lines - residential

- BCPM uses average statewide first and second line penetration data to estimate CB-specific line counts
- HM adjusts for first and second line penetration by considering CBG-specific customer demographics (age & income)
- Scorecard: HM approach is demonstrably more accurate

## Counting lines - business

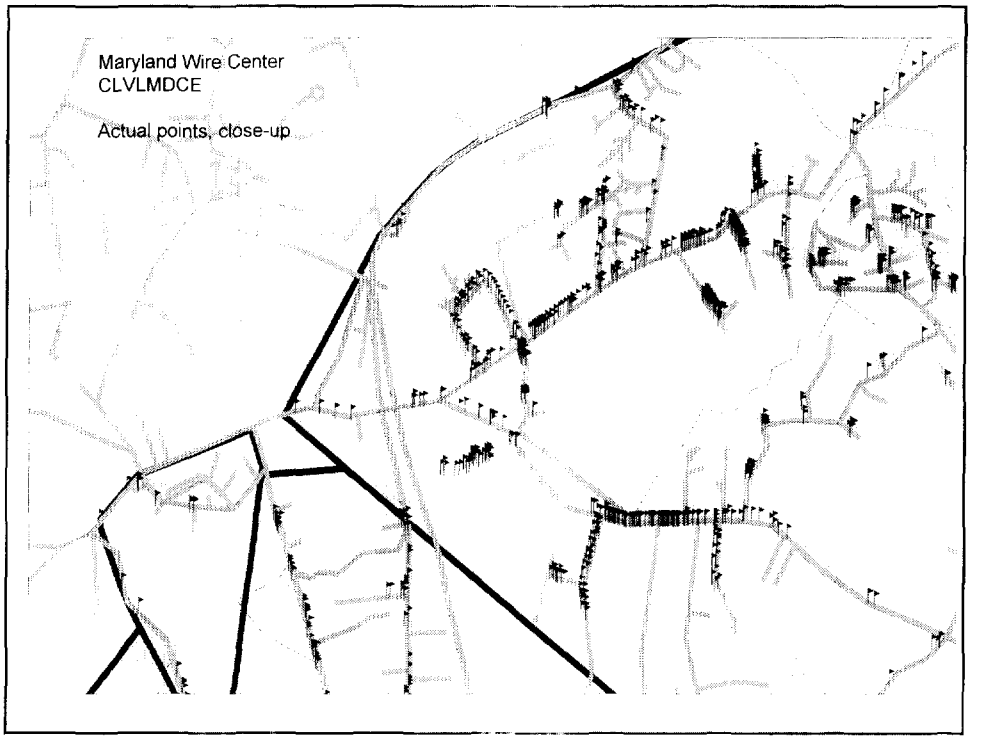
- Both models use PNR National Access Line model
- Hatfield takes this data a step further by normalizing CB-specific business line counts to study area totals

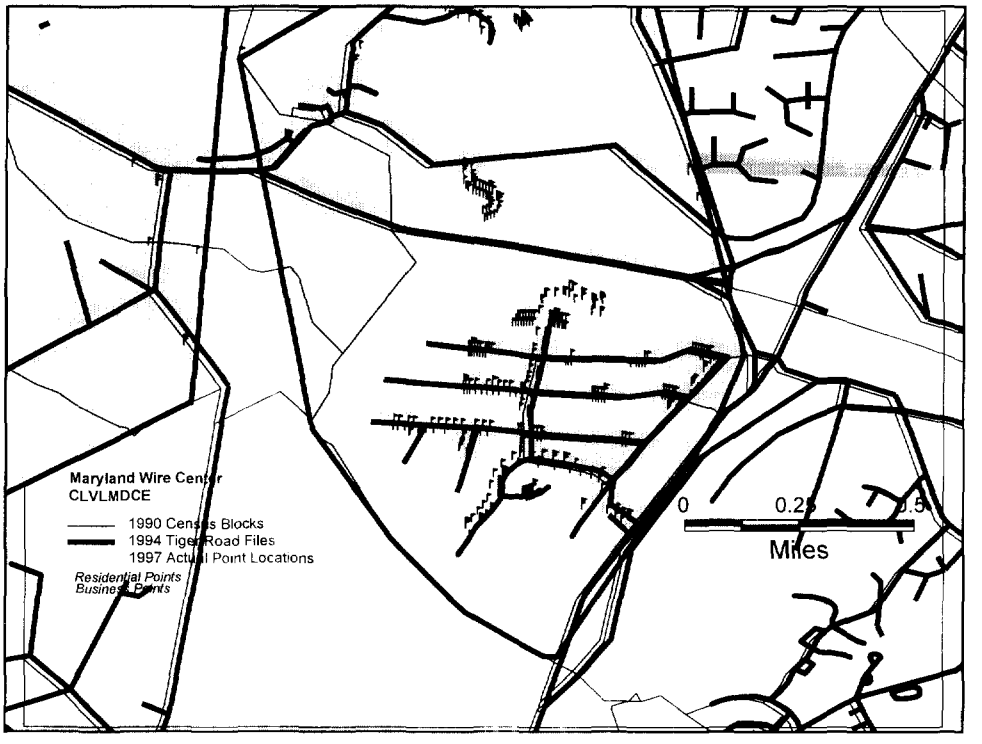
## Locating Customers

- Issue:
  - Urban census blocks are small enough that location of customers within a census block is not an issue.
  - In rural areas, census blocks may be very large, and the location of customers within census blocks is important in estimating network costs

## Locating customers - BCPM

- Customers in rural census blocks are assumed to be uniformly dispersed along roads within an arbitrary "grid" structure
- This assumption is flawed in both concept and application
  - Many roads do not have customers
  - Some customers are not located on known roads
  - Dispersion of customers along roads varies widely


Maryland Wire Center
CLVLMDCE
Actual points, close-up


Maryland Wire Center
CLVLMDCE
1990 Census Blocks
1994 Tiger Road Files
1997 Actual Point Locations
Residential Points
Business Points
0
0.25
0.5
Miles

## Customer Location - HM

- Hatfield Model determines customer location by geocoding actual latitude and longitude
  - accurate to within 50 feet of actual customer location
  - covers >70% of all customer locations in US
  - locations that cannot be geocoded to sufficient accuracy are assumed to be located on census block boundaries

## Customer Location

- Scorecard:
  - BCPM does not accurately locate a single customer
    - census block population assigned to grids containing roads used as a surrogate for customer location
  - Hatfield determines precise location for >70% of all customers
    - where geocoding isn't sufficiently accurate, surrogate method is at least as good as BCPM's

## Clustering Customers

- Issue: Customer locations must be grouped into units that can efficiently be served by telephone plant
  - Proximity of customer locations to each other is key
  - Subject to constraints imposed by engineering practice
    - No analog copper segment may exceed 18 kft
    - Limitation on number of lines that can be served from a single remote terminal

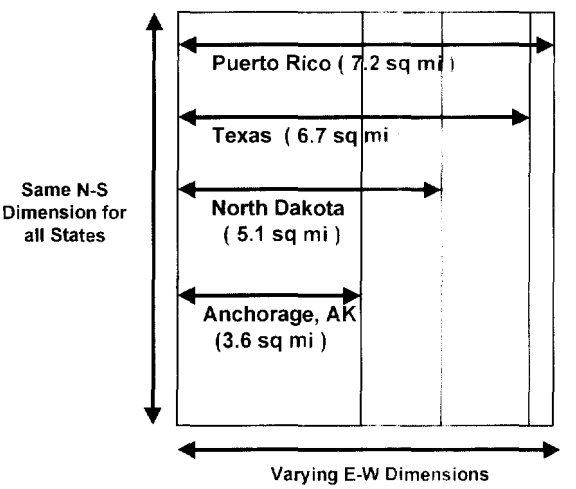
## Clustering Customers

- BCPM uses an arbitrary "grid" structure to determine clusters of customer locations
  - Grids are based on 1/25° of latitude and longitude meridians
  - Road segments to which population is assigned determines which grids will be used as telephone serving areas

# Clustering Customers

- The BCPM grid approach is flawed in several respects:
  - Grid sizes vary systematically from one region of the country to another
  - Imposition of arbitrary grid structure ignores natural clustering of customer locations and increases cost

**BCPM3 Grid Sizes Vary Systematically Across States From North to South**

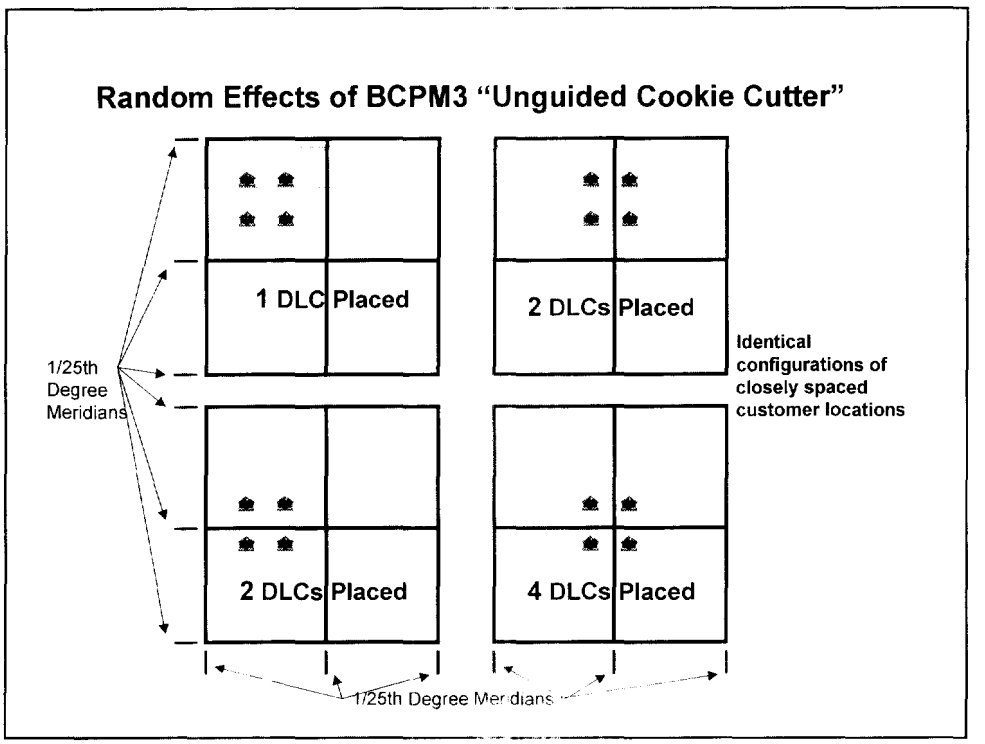



Area of 1/25 degree grid

If Anchorage = 1.00, then:
- North Dakota = 1.42
- Texas = 1.86
- Puerto Rico = 2.00

or,

if North Dakota = 1.00, then:
- Texas = 1.32


Random Effects of BCPM3 "Unguided Cookie Cutter"
1 DLC Placed
2 DLCs Placed
2 DLCs Placed
4 DLCs Placed
1/25th Degree Meridians
Identical configurations of closely spaced customer locations
1/25th Degree Meridians

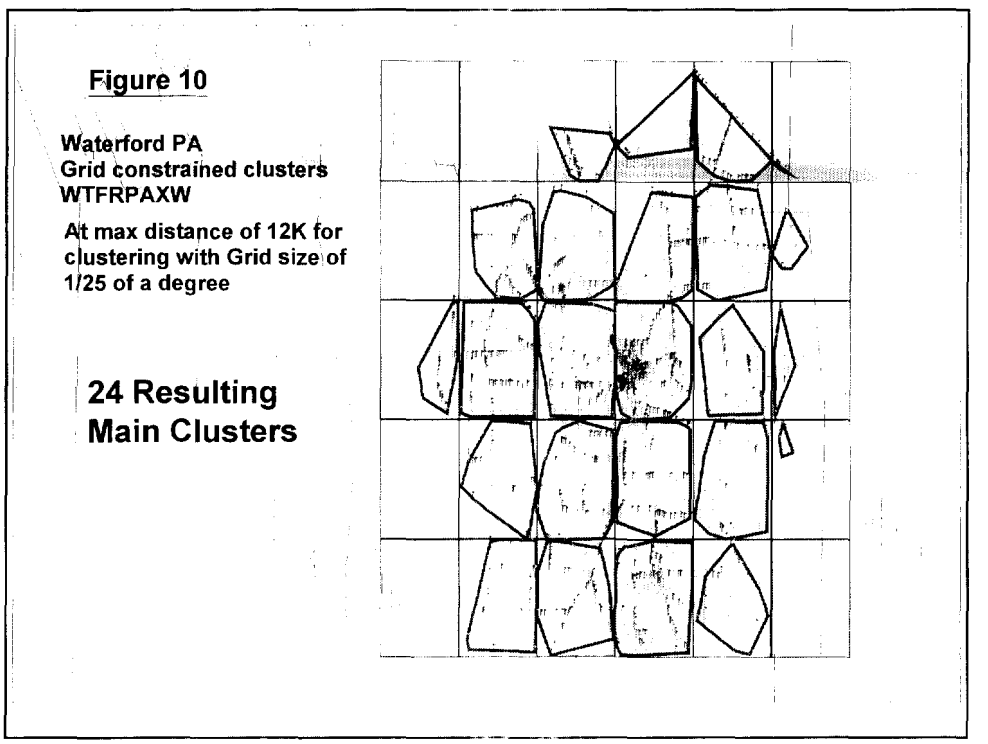


Figure 10
Waterford PA
Grid constrained clusters
WTFRPAXW
At max distance of 12K for clustering with Grid size of 1/25 of a degree
24 Resulting Main Clusters

**Figure 11**

Waterford PA
Unconstrained Clusters
WTFRPAXW
At max distance of 12K for
clustering with no
*grid constraints*

**19 Resulting Main Clusters**

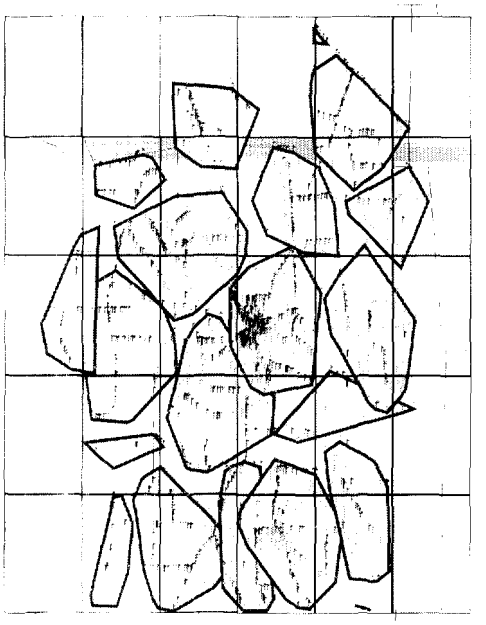
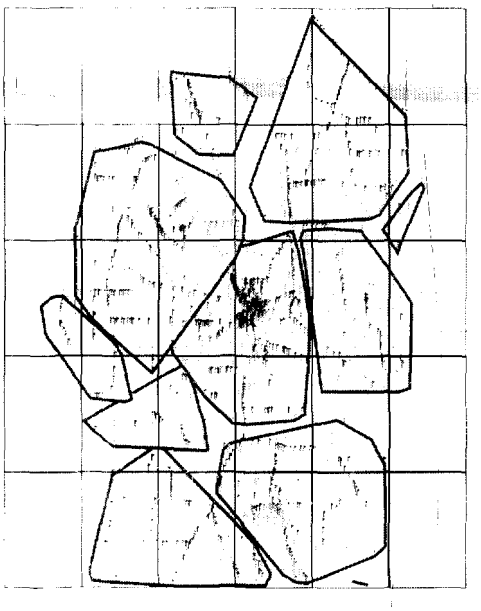


**Figure 12**

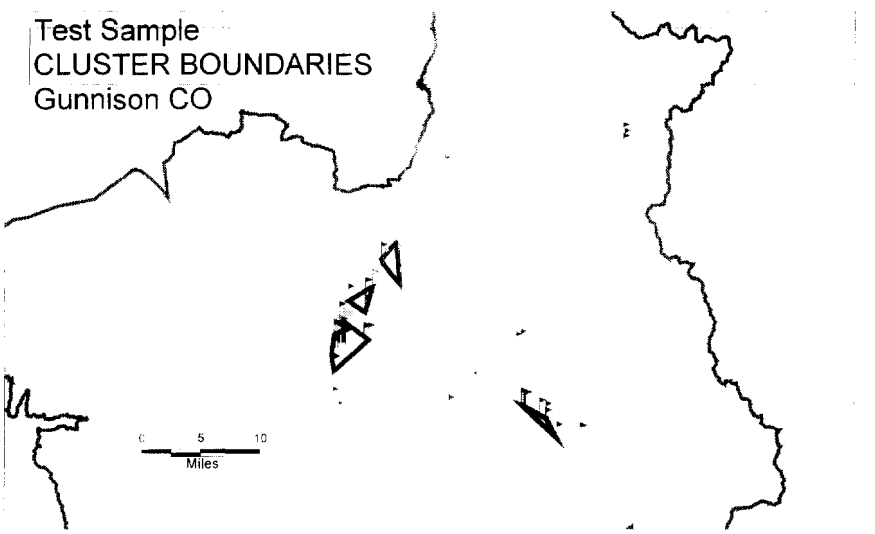
Waterford PA
Unconstrained Clusters
WTFRPAXW
Max distance of 18K for
clustering with no
grid constraints

**10 Resulting Main Clusters**



## Clustering Customers

- Hatfield Model uses a dynamic clustering algorithm that determines natural groupings of customers without respect to artificial boundaries
- Determines both
  - Clusters of customers that are efficiently served through a street grid network
  - Customer locations that are widely dispersed along roads



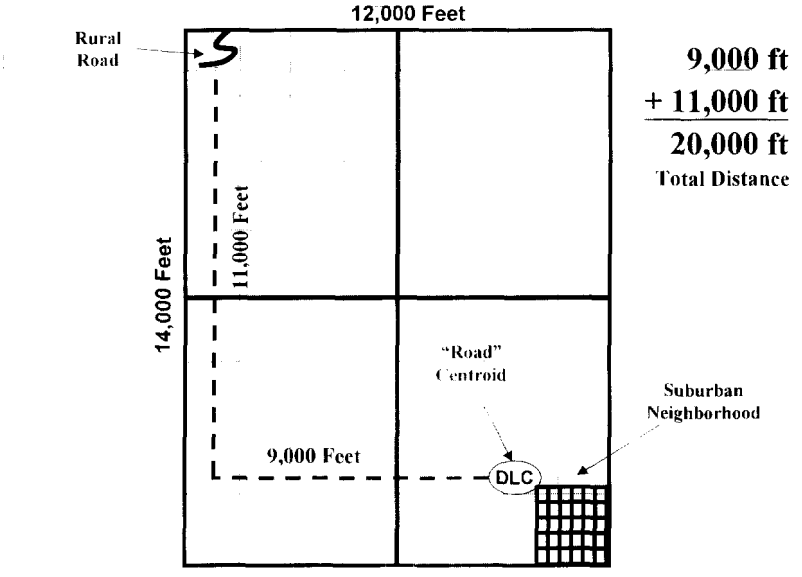
## Customer Location

- BCPM doesn't determine actual clusters of customers, but instead locates customers within an "unguided cookie cutter" pattern
- Hatfield determines clusters of customer locations based on actual customer locations without respect to arbitrary boundaries

## Maximum copper segment length

- Issue: Analog copper cable cannot exceed 18 kft in length if quality of service is to be maintained
- BCPM appears to permit copper segments to exceed this limitation
- Hatfield clustering algorithm assures that no copper segment can exceed the limit

## BCPM3 Permits Copper Loops to Exceed 18,000 Feet

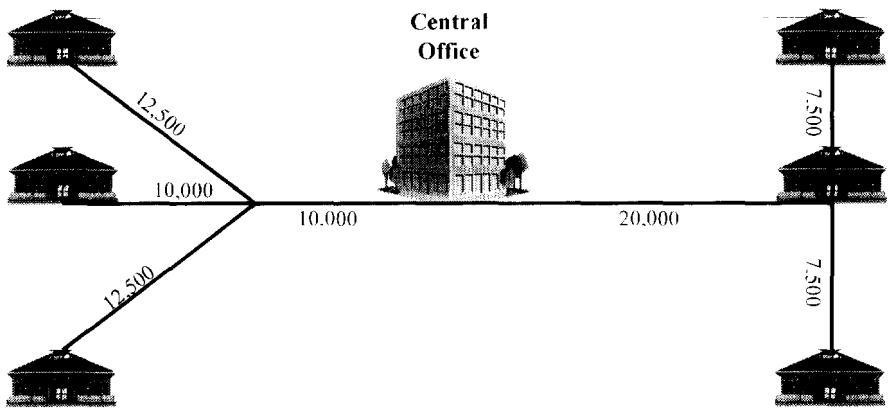



9,000 ft
+ 11,000 ft
20,000 ft
Total Distance

# Efficient Feeder Design

- Issue: Design of feeder plant should reach serving areas with minimum total route distance
- BCPM feeder design minimizes average loop length, but produces higher total route distance
- Hatfield design minimizes total route distance

**BCPM Inflates Route Miles While Reducing Average Distance**




Average Distance = 21,667

Total Route (Structure) Distance = 45,000

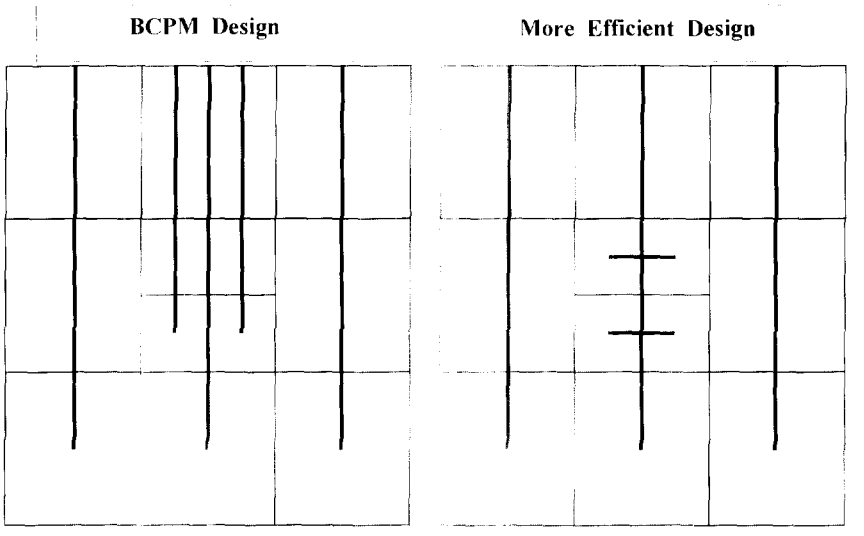
Average Distance = 25,000

Total Route (Structure) Distance = 35,000

# Efficient Feeder Design

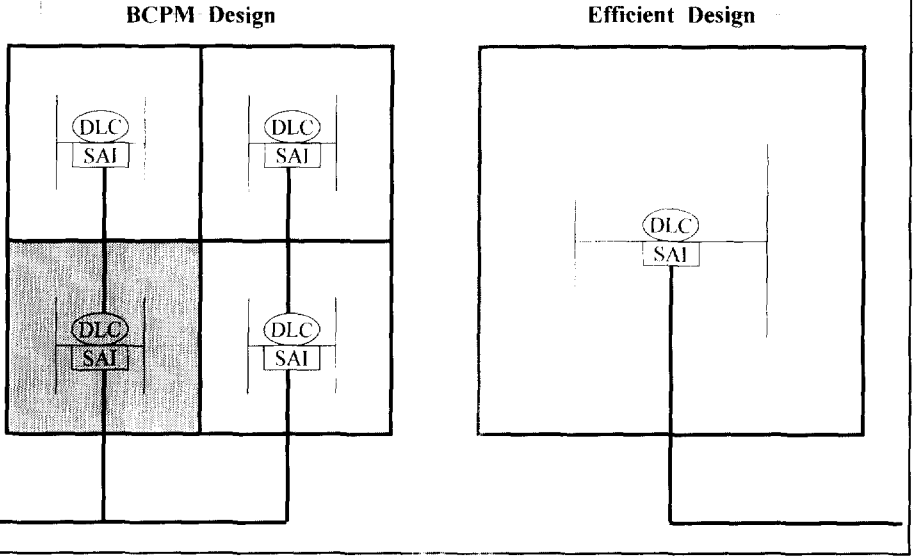
- Issue: Design of subfeeder routes should minimize total route distance
- BCPM runs separate subfeeder routes to each distribution area
- Branching subfeeder cables could serve same locations more efficiently

## BCPM Subfeeder Design is Not Least Cost




*Subfeeder at 1.25 degree*
*Subfeeder to reach smaller grids*

## BCPM Criteria Results in Excessive Serving Areas and Excessive Investment



## Feeder Technology

- Issue: Feeder plant may be either analog copper or digital fiber optic
  - Choice of fiber or copper is affected by many factors that determine cost of each solution
- BCPM uses an arbitrary threshold to determine choice of feeder technology
- Hatfield examines total life cycle costs of each technology and selects least-cost solution

## Switching

- Issue: FNPRM requires that models be open to public scrutiny
- BCPM relies upon proprietary SCM and SCIS cost models for switching costs
  - models are proprietary and "black box" in nature
  - data inputs are proprietary
- Hatfield uses publicly-available data inputs, and all model logic is open to scrutiny

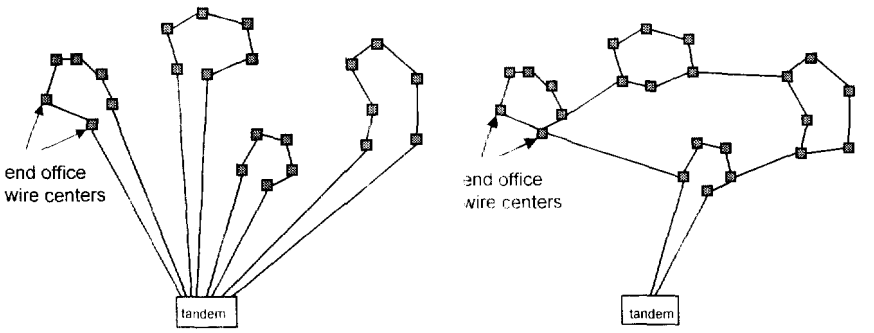
## Interoffice Transport

- Issue: Interoffice transport networks should be based on forward-looking design
- BCPM uses embedded relationships between end office and tandem switches, and embedded mix of host and remote switches
- Hatfield optimizes tandem/end office relationships, and permits specification of optimal mix of host and remote switches

## Interoffice Transport

- Issue: Interoffice networks should be designed to most efficiently connect wire centers and tandems
- BCPM uses rigid assumptions for connecting wire centers to rings and rings to tandems, resulting in inefficiency -- and intersperses multiple companies' offices on a ring
- Hatfield ring-building algorithm efficiently places wire centers on rings, and efficiently connect wire centers and rings to tandems

**Efficient and inefficient tandem ring arrangements:**




*Inefficient ("Lollipop")*

*Efficient ("ring of rings")*

# Signaling

- Issue: Modeling of signaling costs should be integrated into modeling of other components of the network
- BCPM does not model signaling costs
  - Uses input values derived from proprietary model run for US West territory
- Hatfield explicitly models all signaling network components in relationship to other components of network